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| 10/781,353 | 02/17/2004 | Jennifer Wang | P1571 | 9226 |

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| EXAMINER |
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MAI, ANH D

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| ART UNIT | PAPER NUMBER |
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2814

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE | DELIVERY MODE |
|--|------------|---------------|
| 3 MONTHS | 01/31/2007 | PAPER |

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/781,353

Applicant(s)

WANG ET AL.

Examiner

Anh D. Mai

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 November 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
- 4a) Of the above claim(s) 1-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 21-27 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application
- ☐ Other: _____

DETAILED ACTION

Status of the Claims

1. Amendment filed November 20, 2006 is acknowledged. Claim 22 has been amended. New claims 23-27 have been added. Claims 1-27 are pending. Non-elected invention, claims 1-20 have been withdrawn.

Action on merits of claims 21-27 follows.

Claim Objections

2. Claims 23 and 24 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

From claim 22, which is the independent claim, the claimed device appears to contain a hard mask, e.g., a hard mask defining said submicron wide.

According to the specification, the device having a hard mask 30 only exists in Figs. 2, 3 and 4A.

In Figs. 4B and 5, the hard mask 30 have been removed so that “tapered sidewall” is formed.

Claim 23 and 24 recite: “via includes a tapered sidewall”.

As discussed above, if the via includes “tapered sidewall” then there is no more hard mask.

Therefore, claims 23 and 24 fail to further limit claim 22 or contradicting claim 22.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 21-27 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

There does not appear to be a written description of the claim limitation “the via hole comprises an aspect ratio which is greater than 1, and is of substantially the same diameter throughout the depth of the via hole” (claims 21, 22 and 25) in the application as filed.

The description of the via hole 26, as shown in Fig. 3, page 7, [0029], includes: the opening width 50 is 1.66 microns and the bottom width 48 is 1.32 microns. The specification, page 8, [0032], further adds: in contrast, prior wet etching process did not produce *the tapered via hole of the present invention*.

Since the top portion of the via is larger than that of the bottom, the diameter throughout the via are not the same.

Applicant must cancel the new matter in response to the Office Action.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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4. Claims 22-24 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential structural cooperative relationships of elements, such omission amounting to a gap between the necessary structural connections. See MPEP § 2172.01. The omitted structural cooperative relationships are: the **via hole** and the polymer layer or the hard mask or the semiconductor substrate.

5. Claims 22-24 are further rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 22 recites the limitation "whereby the via hole comprises...." in third line from the bottom. There is insufficient antecedent basis for this limitation in the claim.

The "via hole" have never been recited previously, thus, lacking antecedent basis.

Therefore, claims 22-24 are indefinite.

6. Claims 23, 24 and 27 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With respect to claims 23 and 24, claims 23 and 24 recite: "via includes a tapered sidewall".

According to the specification, if the "tapered sidewall" existed, then there is no hard mask.

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Since claims 23 and 24 depend on claim 22, which includes a hard mask, therefore, claims 23 and 24 are indefinite for claiming an element which is no longer existed as far as the product-by-process is concerned.

With respect to claims 24 and 27, claims 24 and 27 recite: wherein the via includes a tapered sidewall extending **at least one-half** of the depth thereof.

However, according to the specification, the tapered sidewall is characterized as: “the tapered portion of via 58 is with the approximate range of **one-third to one-half** the depth of the via 60”.

The “one-half” is the **upper limit** of the tapered portion, not lower limit (at least) as claimed.

Therefore, claims 24 and 27 are indefinite.

7. The claims are generally narrative and indefinite, failing to conform with current U.S. practice. They appear to be a literal translation into English from a foreign document and are replete with grammatical and idiomatic errors.

Applicant should draft the claim as an apparatus so that *all features* of the claimed device can be fully accounted for.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

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A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Claim 25 is rejected under 35 U.S.C. 102(b) as being anticipated by Lin '369.

Insofar as the apparatus is concerned, Lin teaches a device as claimed including:

a polymer layer (20);

a via hole formed in the polymer layer (20), the via hole having at least one vertical sidewall and tapered sidewall;

whereby the via hole comprises an aspect ratio which is greater than 1, and is of substantially the same diameter through out at least one-half the depth of the via hole. (See Figs. 9 and 10).

Product by process limitation:

The expression “a via produced by the process comprising the steps of” and “*placing a hard-mask on a polymer layer; placing a photoresist mask on said hard-mask; releasing a first fluoride gas into a chamber to etch a hard-mask opening for defining a via hole; releasing a second fluoride gas into said chamber to etch an exposed portion of said polymer layer defining said via hole with vertical sidewalls; releasing a third fluoride gas into said chamber to etch an exposed portion of said polymer layer defining said via hole with at least one tapered sidewall*” is/are taken to be a product by process limitation and *are given no patentable weight*. A product by process claim directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See *In re Fessman*, 180 USPQ 324, 326 (CCPA 1974); *In re Marosi et al.*, 218 USPQ 289, 292 (Fed. Cir. 1983); *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688

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(CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935); and particularly *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product “gleaned” from the process steps, which must be determined in a “product by process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old and obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not.

Note that Applicant has burden of proof in such cases as the above case law makes clear.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yu et al. (U.S. Patent No. 6,004,883) in view of Lin (U.S. Pub. No. 2002/0068441) all of record.

With respect to claim 21, insofar as the device is concerned and as best understood by the examiner, Yu teaches a device including a via substantially as claimed including:

- a hard mask (18) on a polymer layer (16);
- a photoresist mask (20) on the hard mask (18)

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at least one via hole (25) with vertical sidewall, defined in the polymer layer (16), and is of substantially the same diameter throughout the depth of the via hole (25). (See Figs. 2-3).

Thus, Yu is shown to teach all the features of the claim with the exception of explicitly disclosing the aspect ratio of the via.

However, Lin teaches via (7) defined in a polymer layer (5) having an aspect ratio of greater than 1 are routinely used to for the contact in ULSI, and is of substantially the same diameter throughout the depth of the via hole.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to define the via of Yu having an aspect ratio of greater than 1 in the polymer layer as taught by Lin to form contacts to a lower layer.

Furthermore, it would have been an obvious matter of design choice to define a via having aspect ratio greater than 1, since such a modification would have involve a mere change in the size of a component. A change in size is generally recognized as being within the level of ordinary skill in the art. *In re Rose*, 105 USPQ 237 (CCPA 1955).

Product by process limitation:

The expression “a via produced by the process comprising the steps of” and “*placing*” and “*releasing a first fluoride gas into a chamber to etch a hard-mask opening for defining said via hole; and releasing a second fluoride gas into said chamber to etch an exposed portion of said polymer layer defining said via hole with vertical sidewalls*” is/are taken to be a product by process limitation and *are given no patentable weight*. A product by process claim directed to the

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product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See *In re Fessman*, 180 USPQ 324, 326 (CCPA 1974); *In re Marosi et al.*, 218 USPQ 289, 292 (Fed. Cir. 1983); *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935); and particularly *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product “gleaned” from the process steps, which must be determined in a “product by process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old and obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not.

Note that Applicant has burden of proof in such cases as the above case law makes clear.

10. Claims 22-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu ‘883 in view of Lin (U.S. Pat No. 6,515,369).

With respect to claim 22, insofar as the device is concerned and as best understood by the examiner, Yu teaches a device including a via substantially as claimed including:

- a semiconductor substrate (10);
- a polymer layer (16) formed on the semiconductor substrate (10);
- a hard mask (18) on the polymer layer (16)

whereby the via hole (25) comprises an aspect ratio, and is of substantially the same diameter (vertical sidewall) through out at least one-half the depth of the via hole (25). (See Figs. 2-3).

Thus, Yu is shown to teach all the features of the claim with the exception of explicitly disclosing the aspect ratio of the via hole.

However, Lin '369 teaches via hole (21) comprises an aspect ratio which is greater than 1, and is of substantially the same diameter through out at least one-half the depth of the via hole (21) defined in a polymer layer (20). (See Fig. 5a).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to define the via hole of Yu having an aspect ratio of greater than 1 in the polymer layer as taught by Lin to form contacts to a lower layer.

Furthermore, it would have been an obvious matter of design choice to define a via having aspect ratio greater than 1, since such a modification would have involve a mere change in the size of a component. A change in size is generally recognized as being within the level of ordinary skill in the art. *In re Rose*, 105 USPQ 237 (CCPA 1955).

Product by process limitation:

The expression "a via produced by the process comprising the steps of" and "*placing in chamber... defining a submicron wide via-opening deposited on said semiconductor substrate*" and "*releasing a fluoride gas into said chamber*" is/are taken to be a product by process limitation and *are given no patentable weight*. A product by process claim directed to the product

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per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See *In re Fessman*, 180 USPQ 324, 326 (CCPA 1974); *In re Marosi et al.*, 218 USPQ 289, 292 (Fed. Cir. 1983); *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935); and particularly *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product “gleaned” from the process steps, which must be determined in a “product by process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old and obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not.

Note that Applicant has burden of proof in such cases as the above case law makes clear.

With respect to claims 23 and 24, insofar as the final structure is concerned, in view of Lin, the via includes a tapered sidewall extending to depth thereof. (See Figs. 9 and 10).

Thus, Yu and Lin is shown to teach all the features of the claim with the exception of explicitly disclosing the tapered sidewall extending at least one-third or one-half of the depth.

Note that the specification contains no disclosure of either the *critical nature of the claimed extending of the tapered sidewall in the range from one-third to one-half* of any unexpected results arising therefrom. Where patentability is aid to based upon particular chosen dimension or upon another variable recited in a claim, the Applicant must show that the chosen

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dimension are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the via of Yu to have tapered sidewall as taught by Lin so that contact to the lower pad can be made.

11. Claims 26 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin '369.

With respect to claims 26 and 27, insofar as the final structure is concerned, and as best understood by the examiner, the via of Lin includes a tapered sidewall (upper portion) extending to the depth thereof. (See Figs. 9 and 10).

Thus, Lin is shown to teach all the features of the claim with the exception of explicitly disclosing the tapered sidewall extending at least one-third or one-half of the depth.

Note that the specification contains no disclosure of either the *critical nature of the claimed extending of the tapered sidewall in the range from one-third to one-half* of any unexpected results arising therefrom. Where patentability is aid to based upon particular chosen dimension or upon another variable recited in a claim, the Applicant must show that the chosen dimension are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the tapered portion of the via of Lin so that contact to the lower pad can be made.

Response to Arguments

12. Applicant's arguments filed November 20, 2006 with respect to claim 21 have been fully considered but they are not persuasive.

Rejection under 35 U.S.C. 112, first paragraph:

For the support of the limitation "substantially the same diameter throughout the depth of the via hole", Applicant pointed to paragraph [0026] and asserts:

This disclosure in the written description supports the claim limitation that the walls of the via hole are vertical, and by virtue of the sidewalls being vertical, the via hole is "substantially the same diameter" throughout its depth.

However, the term "vertical" is mean at best, up-right, (see [0017]). As shown in Fig. 3, as the result of the etch, the via hole 26 is vertical, but the top portion and the bottom portion are differed in size, e.g., portion 48 is smaller than portion 50.

It appears that the Applicant recognizes the sizes difference between the top and bottom portions to be 0.34 micron. In the model semiconductor process, where a device can be made as small as 45 nm, a 0.34 micron means 340 nm which is approximately 10 time the size of a device. It is the Applicant that should appreciate the difference.

Therefore, the term "substantially the same diameter" is not just contradicting the specification but also lacking support.

There rejection is therefore, maintained.

Rejection under 35 U.S.C. 103(a):

Applicant argues:

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The method taught by Yu is unable to etch the sophisticated via holes of the present invention.

It is no double that the method of the present invention is very sophisticated. However, Applicant appears to present an argument regarding his method, while the claimed invention is about an apparatus. Therefore, any argument with respect to a sophisticate method is irrelevant.

Applicant further argues that since the device of Yu has a lower via, e.g., staggered, thus is a different device.

However, the limitations of the claim fail to preclude a via hole to have a lower portion. Note that, the via hole (25) in the polymer layer (16) of Yu does have a substantially the same diameter throughout the depth of via (25). (See Fig. 3).

With respect to Lin, Applicant recognizes that via hole in a polymer layer having an aspect ratio of greater than 1 is well known in the art.

Therefore, the combination of the references clearly renders the claim obvious.

The rejection is, therefore, maintained.

13. Applicant's arguments with respect to amended claim 22 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

14. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).


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A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (571) 272-1710. The examiner can normally be reached on 8:00AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


ANH D. MAI
PRIMARY EXAMINER